COMPARISON OF REMOTE SENSING MEASUREMENTS WITH A TWO-SCALE POLARIMETRIC EMISSION AND SCATTERING MODEL FOR SEA SURFACES

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Abstract

Recently, it has been observed that the brightness temperatures of sea surfaces correlate with the azimuth angle of the ocean wind vector, indicating that ocean wind direction can not only be retrieved from the microwave backscatter, but also from the brightness temperature measurements. In this paper, comparison of the theoretical results calculated from a two-scale emission and scattering model with the Seasat and SSM/I model functions and aircraft measurements is presented and potential applications of microwave polarimetry are discussed. In our two-scale model, the modified reflectivities of large scale surfaces are calculated by extending the small perturbation method to the second order for small scale perturbation with anisotropic directional spectrum. It was found that the modified reflectivities derived from the second-order scattered field agree excellently well with the results obtained from a Monte Carlo simulation technique which numerically calculates the polarimetric reflectivities of one-dimensional random rough surfaces with a power-law spectrum. Without the second-order correction, the modified reflectivities of the rough surfaces are significantly over-estimated and sign errors are observed in the third and fourth Stokes parameters for thermal emissions. The surface spectrum parameters and two-scale cutoff are selected so that the calculated scattering and emission signatures agree with the reported model functions for Seasat and SSM/I. Subsequently, the polarimetric signatures of sea surfaces are illustrated to indicate the possibility of reducing the number of azimuthal looks required for spaceborne sensors in the remote sensing of ocean wind by using the polarimetric information. Furthermore, it is found that contrary to the dependence of backscattering coefficients on incidence angles, polarimetric brightness temperatures display a stronger wind direction dependence in the near nadir-looking direction than away from nadir. Finally, we discuss the potential of a single-look polarimetric radiometer for wind retrieval.